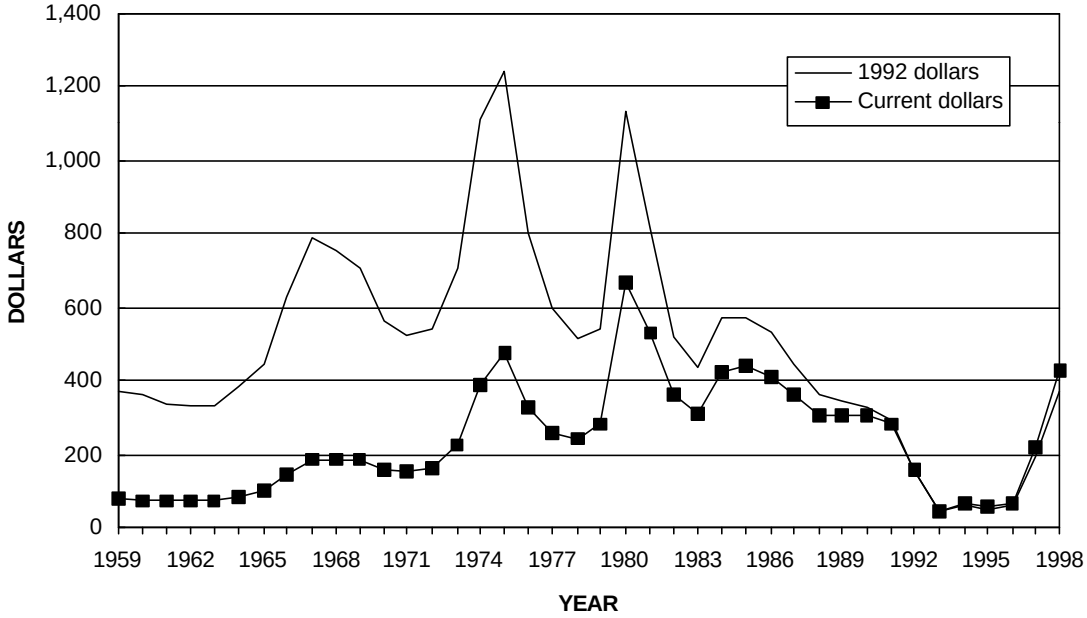
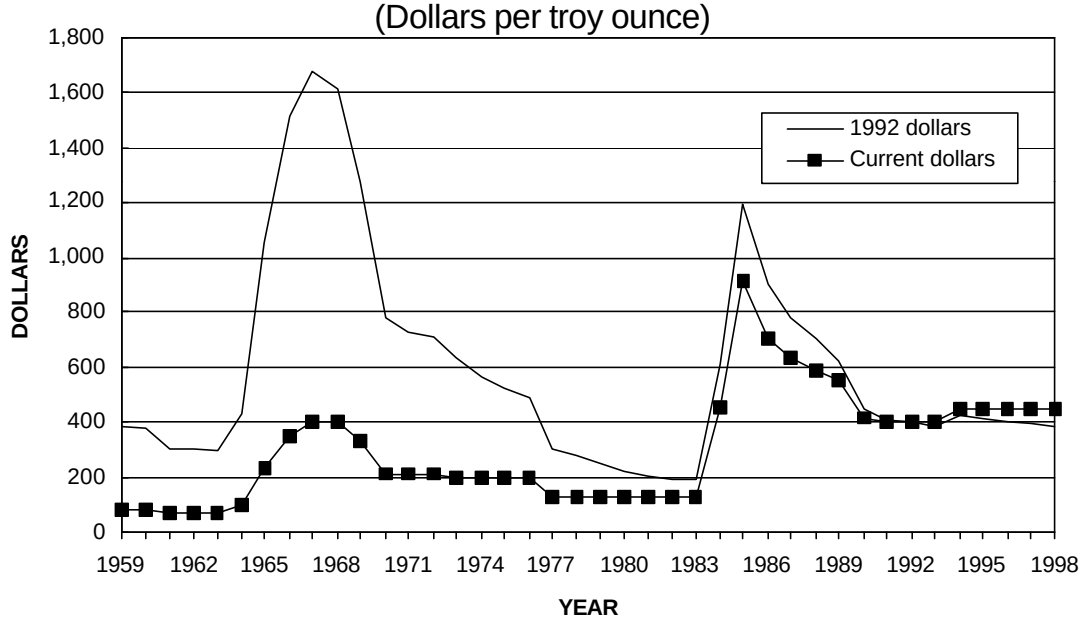
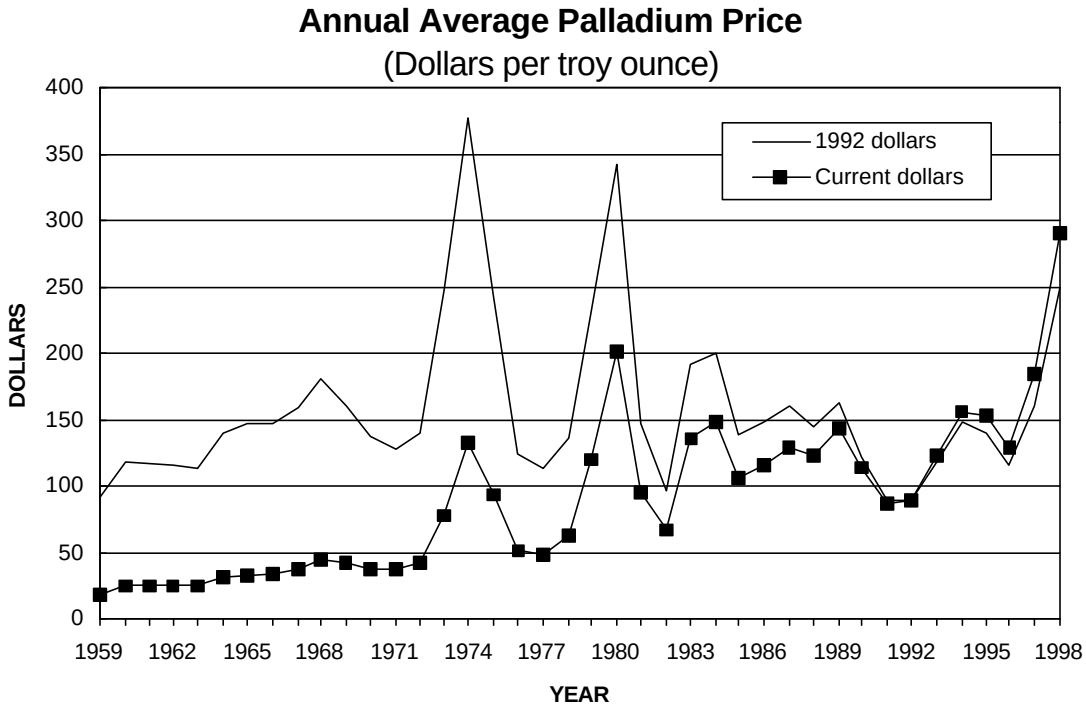
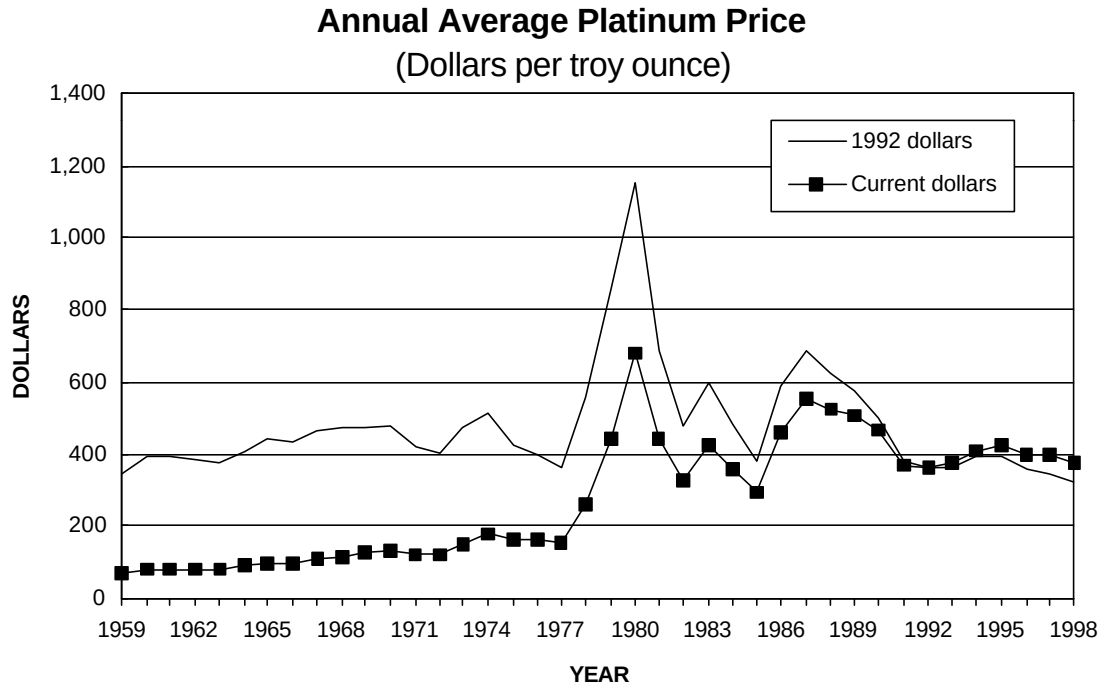
Annual Average Iridium Price
(Dollars per troy ounce)



Annual Average Osmium Price
(Dollars per troy ounce)

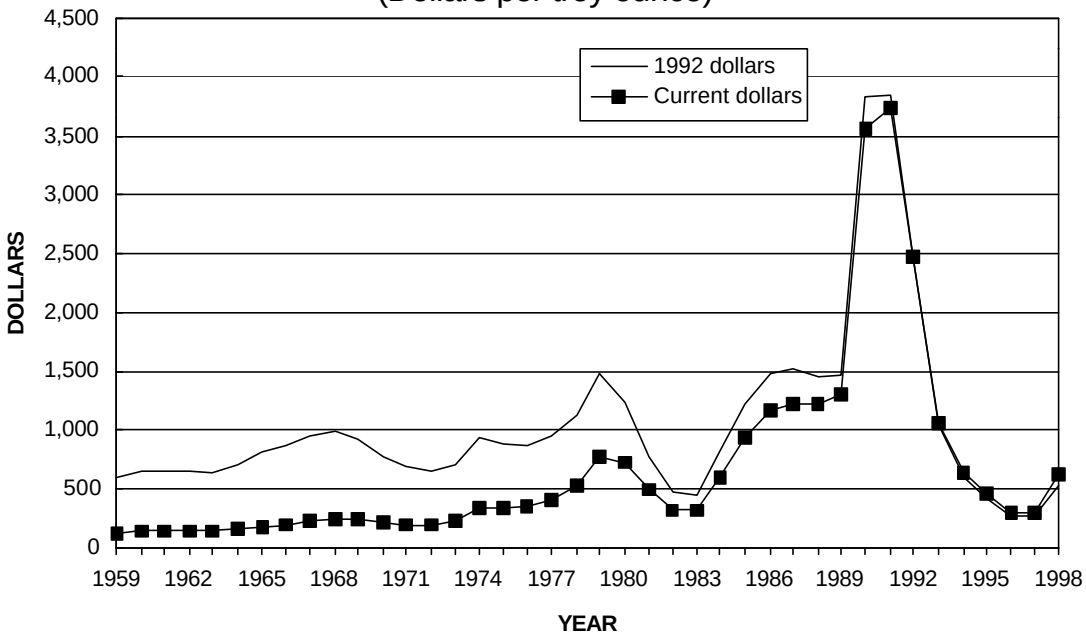



Annual Average Palladium Price
(Dollars per troy ounce)
400
350
300
250
200
150
100
50
0
DOLLARS
1992 dollars
Current dollars
1959
1962
1965
1968
1971
1974
1977
1980
1983
1986
1989
1992
1995
1998
YEAR


Annual Average Platinum Price
(Dollars per troy ounce)
1,400
1,200
1,000
800
600
400
200
0
DOLLARS
1992 dollars
Current dollars
1959
1962
1965
1968
1971
1974
1977
1980
1983
1986
1989
1992
1995
1998
YEAR

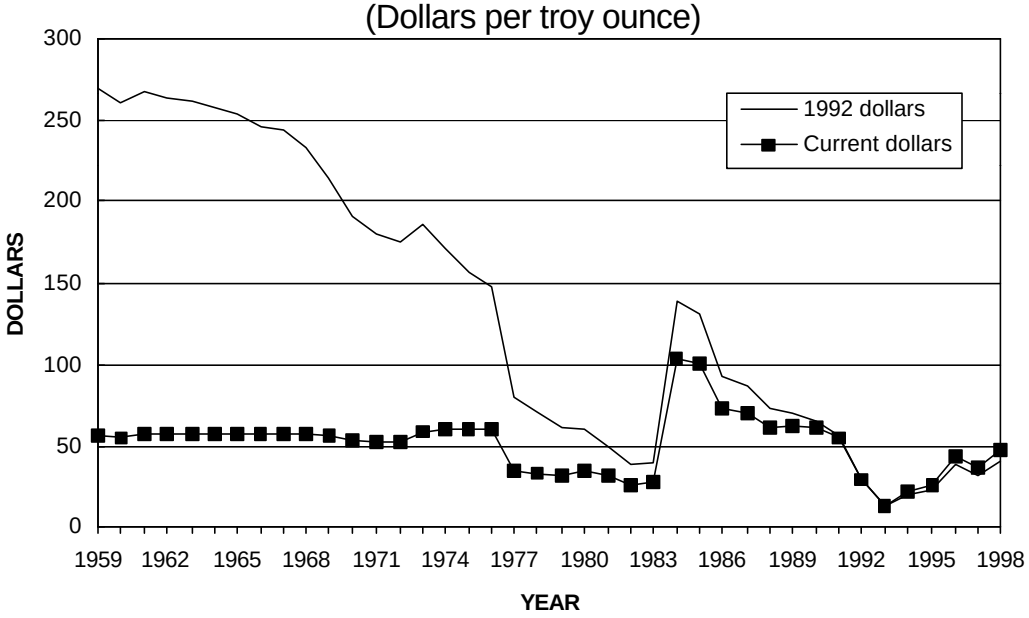
Annual Average Rhodium Price

(Dollars per troy ounce)



Annual Average Ruthenium Price

(Dollars per troy ounce)



Significant events affecting platinum-group metals (PGM) prices since 1958

1964-68	Tight supply for platinum owing to start-up demands for new petroleum refineries
1971	PGM price declines owing to expansion of production in South Africa and economic recessions in the United States and other countries
1973	Anticipated demand for platinum and palladium in automobile catalytic converters in the United States puts pressure on prices, catalytic converters first used in 1974
1980	Strong investor speculation pushes up prices for all precious metals
1983	Rustenburg Platinum Holdings Ltd. in South Africa suspends its producer price quotations for PGM, increased trading of futures contracts on the New York Mercantile Exchange (NYMEX)
1984	Price increase for rhodium because of higher demand for rhodium in automobile three-way catalytic converters
1986	Platinum price increase after a work stoppage at Impala Platinum Holdings Ltd. in South Africa

Naturally occurring platinum and platinum-rich alloys have been known for a long time. The Spaniards named the metal "platina," or little silver, when they first encountered it in Colombia. They regarded platinum as an unwanted impurity in the silver they were mining. Today, 98% of the world's primary platinum-group metals (PGM) production comes from four countries—South Africa (66%), Russia (23%), the United States (5%), and Canada (4%). The ratio of palladium to platinum in individual PGM ores varies from country to country. South Africa produces about twice as much platinum as palladium, whereas Russia produces about three times as much palladium as platinum (Conradie, 1997, p. 34-40). In Canada, PGM are byproducts of nickel ore processing. The expanding U.S. production of PGM is centered in the Stillwater Complex in Montana. The Stillwater and East Boulder Mines are primary PGM producers with small amounts of byproduct nickel, cobalt, and gold.

The catalytic properties of the six PGM—iridium, osmium, palladium, platinum, rhodium, and ruthenium—are outstanding. Platinum's wear and tarnish resistance characteristics are well suited for making fine jewelry. Other distinctive properties include resistance to chemical attack, excellent high-temperature characteristics, and stable electrical properties. All these properties have been exploited for industrial applications. Platinum, platinum alloys, and iridium are used as crucible materials for the growth of single crystals, especially oxides. The chemical industry uses a significant amount of either platinum or a platinum-rhodium alloy catalyst in the form of gauze to catalyze the partial oxidation of ammonia to yield nitric oxide, which is the raw material for fertilizers, explosives, and nitric acid. In recent years, a number of PGM have become important as catalysts in synthetic organic chemistry. Ruthenium dioxide is used as coatings on dimensionally stable titanium anodes used in the production of chlorine and caustic soda. Platinum supported catalysts are used in the refining of crude oil, reforming, and other processes used in the production of high-octane gasoline and aromatic compounds for the petrochemical industry. Since 1979, the automotive industry has emerged as the principal consumer of PGM. Palladium, platinum, and rhodium have been used as oxidation catalysts in catalytic converters to treat automobile exhaust emissions. A wide range of PGM alloy compositions is used in low-voltage and low-energy contacts, thick- and thin-film circuits, thermocouples and furnace components, and electrodes (Hilliard and Dunning, 1983, p. 129-142).

The most important prices for PGM have been the South African producer prices and the free-market prices fixed daily on the commodity exchanges. In terms of total value of PGM traded, the most important exchange is NYMEX. Producer prices give a certain amount of stability to the platinum and palladium markets. From about 1980 onward, however, the free-market price of platinum fell to well below the producer price, putting pressure on the producer price and inducing consumers to buy increasing quantities on the free market to meet their requirements. Also, the increased growth of investments in platinum added more pressure on producers to adopt a more realistic price level. Consequently, South African producers largely abandoned producer prices and adopted a pricing policy that more closely reflected market conditions. NYMEX and the Tokyo Commodity Exchange for Industry trade PGM on the open market. Russia, the world's largest palladium producer, sells palladium and other PGM through the Government agency Almazjuvelirexport (Roskill Information Services Ltd, 1991, p. 195-197).

Beginning in 1957 and continuing through 1958, a drop in demand for platinum by domestic petroleum refiners and persistent selling pressure by the U.S.S.R. at discount prices caused the platinum price to tumble to the lowest level in a decade. Soviet sales brought a corresponding decline in the price of palladium to the lowest level since 1933. In 1959, prices for platinum and palladium advanced, reversing the trend of 1957 through 1958. The more orderly selling policy by the U.S.S.R. was a significant factor in the PGM market recovery. Also, U.S. Government purchases contributed to the higher price of palladium.

In spring 1963, the U.S.S.R. disrupted the orderly marketing of PGM by selling large amounts of metal at below-market prices but curtailed its offerings later in the year. U.S. consumption of PGM reached the highest amount

in history, more than 1 million ounces. The largest use for platinum was in the chemical industry, and the largest use for palladium was in the electrical industry (Ware, 1963, p. 901).

From 1964 to 1968, supplies of platinum were tight, putting upward pressure on prices. In 1965, U.S. suppliers allocated platinum to established customers at $100 per ounce. U.S. purchases of platinum were up sharply owing to the construction of new petroleum refineries. Prices for PGM during 1967 reflected the short supplies that persisted throughout the year. Although the producer price for platinum showed a small increase, dealer prices were up sharply. At the start of 1967, the producer price for platinum was $100 per ounce. On January 24, the price was increased to $109 to $112 per ounce and was unchanged until December when sales were made at $125. Dealer prices, which started the year at $157 to $160 per ounce, began to increase in May and were $225 to $230 by yearend. The producer price of palladium, which was $35 to $37 per ounce in October 1966, increased to $37 to $39 in January 1967 and remained unchanged for the remainder of the year. The price of rhodium was $197 to $299 per ounce in January 1969, increased in March and again in December, and closed out the year at $245 to $250. During the following year, dealer prices were two to three times as much as producer prices.

In 1971, prices of PGM declined owing to recession in the United States and other countries and the expansion of platinum capacity in South Africa. In each of the previous 8 years, South Africa increased its output. On the strength of an upturn in consumption and growing anticipation that PGM might be needed in a few years for automotive exhaust emissions control, prices and production posted significant increases in 1972. By the second quarter of 1972, U.S. dealer prices for platinum and palladium had exceeded producer prices. By midyear, the dealer price for iridium had increased from $145 to $148 per ounce to $525. Production and price trends continued the upward trend in 1973. Producer prices, which were under Government control much of the year, increased by 10% to 50% in February, fluctuated between narrow limits in June, and then advanced again in late September. After price controls were removed from most nonferrous metals in December, rhodium and iridium increased by another 14% to 15%. Ruthenium remained unchanged after a February increase to $60 per ounce, and osmium stayed at $200 per ounce through the year. The dealer price of iridium jumped from $250 to $450 per ounce in July, as the metal became scarce, and ended the year at $525 per ounce (Butterman, 1973, p. 1040).

PGM prices were mostly flat from 1975 through 1977. In 1977, the producer price for platinum was steady at $162 per ounce. The producer price for palladium began 1977 at $55 per ounce, increased to $60 in late January, and remained at that level for the remainder of the year. The price of rhodium was about $400 per ounce at the beginning of the year and increased to $450 in March owing to increased industrial demand and speculation regarding the use of rhodium in automotive catalytic converters. Iridium started the year at $300 per ounce, decreased to $250 in June and, returned to $300 for the remainder of the year. The price of osmium was $200 per ounce for the first 6 months of 1977 but declined to around $150 in the last 6 months of the year owing to continued weak demand. The price of ruthenium remained at around $60 per ounce throughout the year.

From 1978 to 1980, prices of platinum rose substantially owing to strong investor interest, chronic world inflation, and tight supply. In 1980, platinum, gold, and silver prices soared as a result of speculative activity. The platinum dealers price peaked at $990 per ounce in March 1980. Palladium prices moved up moderately in 1978 and more sharply in 1979 partly owing to increased investor interest. Rhodium prices increased only moderately in 1978, but in 1979 the price increased sharply. This was in response to larger purchases of the metal by the automotive industry for use as automotive emissions control catalyst.

In 1981 and 1982, lower world demand for PGM resulted in lower prices. In 1983, dealer prices for platinum and palladium increased substantially. A major South African producer, Rustenburg Platinum Holdings Ltd., suspended its producer prices for PGM and began selling most of its output at market prices. Platinum and palladium were recognized more as world commodities rather than commodities controlled exclusively by South African producers. Trading activity in futures contracts on NYMEX increased substantially.

In 1984, the dealer price for rhodium nearly doubled because of higher demand for rhodium in automobile three-way catalytic converters. The automotive industry became the dominant user of rhodium in the early 1980's.

In 1986, the dealer price for platinum increased by 60% owing to a work stoppage at Impala Platinum Holdings Ltd. in South Africa and anticipation that U.S. imports of platinum from South Africa would be cut off because of the antiapartheid legislation passed by the U.S. Congress. PGM were later exempted from the Anti-Apartheid Act of 1986.

In December 1988, the platinum market reacted strongly to an announcement by Ford Motor Company that it had developed a platinum-free automobile catalyst. Spot platinum prices fell to $100 per ounce on the day of the announcement, and futures prices in New York fell the limit of $25 for two consecutive days. The average dealer price for platinum in December was $557 per ounce. By January 1989, the average price had fallen to $528 per ounce.

From 1990 to 1998, the annual average New York dealer price of platinum fluctuated within the relatively narrow range of $375 and $475 per ounce. The price history of palladium was similar. The price of rhodium, however, was dramatically different.

In the late 1970's, market economy countries began implementing measures to reduce pollutants in automobile exhausts. The emphasis on controlling air pollution resulted in increased demand for PGM. Palladium-rhodium and

platinum-rhodium oxidation catalysts were developed for use in catalytic converters. The increased demand caused the annual average price of rhodium to increase from $312 per ounce in 1983 to $929 in 1985. From 1986 to 1988, the monthly average New York dealers price of rhodium ranged from $1,150 to $1,300 per ounce. In early 1989, the announcement of problems at South Africa's Rustenburg Platinum precious metals refinery caused the price to jump to more than $2,000 per ounce. By July 3, 1990, rhodium was being quoted at $7,000 per ounce. This level could not be sustained, but the price fell no lower than $4,100 per ounce in November, reached $4,500 in early December, and rose sharply to $5,300 in the last week of 1990. Starting in 1992, the price trend of rhodium turned downward. This was brought on by recession in market economy countries, reduced sales of automobiles and, consequently, reduced demand for automobile catalysts. Demand sank even lower as U.S. automakers made wider use of palladium-only technology instead of platinum-rhodium or palladium-rhodium catalysts. In January 1997, the rhodium price sank to $200 per ounce, its lowest level in nearly 24 years. Prices began to rise again in June, reaching a peak of $370 per ounce, as delayed shipments from Russia caused a shortage of supply. The price retreated to $300 per ounce in August but rallied to $360 at yearend, following speculative buying in the United States. Prices continued to rise in 1998, reaching $640 in April, its highest level since 1994 (Platt's Metals Week, 1998).

From 1990 to 1996, prices for ruthenium and iridium remained mostly unchanged within narrow limits. Supply and demand were in balance and there was little or no upward pressure on prices. At the start of 1997, strong consumer purchasing coupled with increasingly limited availability caused the price of iridium to advance from $110 per ounce to $200 in late January. The price reached $290 in October but eased slightly to $270 at yearend. Strong consumer purchasing and continued tight supply lifted the price to $575 in April 1998. The price subsequently began to ease, as industrial demand slackened and the supply situation improved.

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Annual Average Iridium Price

(Dollars per troy ounce[1])

Year	Price	Year	Price	Year	Price	Year	Price
1911	62	1933	58	1955	103	1977	258
1912	65	1934	59	1956	105	1978	240
1913	65	1935	57	1957	105	1979	280
1914	65	1936	104	1958	77	1980	666
1915	83	1937	88	1959	77	1981	529
1916	94	1938	69	1960	76	1982	359
1917	150	1939	113	1961	72	1983	309
1918	175	1940	169	1962	72	1984	424
1919	255	1941	183	1963	73	1985	438
1920	331	1942	168	1964	85	1986	414
1921	195	1943	165	1965	100	1987	363
1922	200	1944	165	1966	145	1988	306
1923	NA	1945	165	1967	188	1989	303
1924	293	1946	139	1968	188	1990	307
1925	363	1947	92	1969	185	1991	283
1926	169	1948	108	1970	156	1992	158
1927	120	1949	104	1971	152	1993	47
1928	294	1950	146	1972	162	1994	66
1929	238	1951	200	1973	223	1995	55
1930	179	1952	192	1974	391	1996	68
1931	114	1953	178	1975	477	1997	218
1932	68	1954	213	1976	325	1998	430

NA Not available

[1]To convert to dollars per kilogram, multiply by 32.1507.

Note:

1911-29, New York price of refined metal, *in* Hill., J.M., 1922, The marketing of platinum: Engineering & Mining Journal-Press, p. 718.

1930-66, Producer price at New York of 99%-pure iridium, *in* Engineering & Mining Journal, Mineral and Metal Markets.

1967-93, Metals Week New York Dealer, f.o.b. New York, spot, estimated market price for minimum 99%-pure iridium, *in* Metals Week [through June 14, 1993].

1993-98, Metals Week New York Dealer, f.o.b. New York, spot, estimated market price for minimum 99%-pure iridium, *in* Platt's Metals Week.

Annual Average Osmium Price

(Dollars per troy ounce[1])

Year	Price	Year	Price	Year	Price	Year	Price
1930	67	1948	100	1966	350	1984	455
1931	67	1949	100	1967	400	1985	915
1932	62	1950	141	1968	400	1986	704
1933	63	1951	208	1969	335	1987	633
1934	68	1952	208	1970	215	1988	592
1935	50	1953	166	1971	210	1989	549
1936	55	1954	144	1972	212	1990	416
1937	57	1955	96	1973	200	1991	400
1938	57	1956	90	1974	200	1992	400
1939	57	1957	90	1975	200	1993	400
1940	57	1958	80	1976	200	1994	450
1941	47	1959	80	1977	130	1995	450
1942	47	1960	80	1978	130	1996	450
1943	50	1961	65	1979	130	1997	450
1944	50	1962	65	1980	130	1998	450
1945	50	1963	65	1981	130		
1946	67	1964	95	1982	130		
1947	100	1965	236	1983	132		

[1]To convert to dollars per kilogram, multiply by 32.1507.

Note:

1930-66, Producer price at New York of 99.5%-pure osmium, *in* Engineering & Mining Journal, Mineral and Metal Markets.

1967-93, Metals Week New York Dealer, f.o.b. New York, spot, estimated market price for minimum 99.5%-pure osmium, *in* Metals Week [through June 14, 1993].

1993-98, Metals Week New York Dealer, f.o.b. New York, spot, estimated market price for minimum 99.5%-pure osmium, *in* Platt's Metals Week.

Annual Average Platinum Price

(Dollars per troy ounce[1])

Year	Price	Year	Price	Year	Price	Year	Price
1880	4	1910	33	1940	36	1970	133
1881	4	1911	43	1941	36	1971	121
1882	3	1912	45	1942	36	1972	121
1883	3	1913	45	1943	35	1973	150
1884	3	1914	45	1944	35	1974	181
1885	1	1915	47	1945	35	1975	164
1886	2	1916	83	1946	53	1976	162
1887	4	1917	103	1947	62	1977	157
1888	4	1918	106	1948	92	1978	261
1889	4	1919	115	1949	75	1979	445
1890	4	1920	111	1950	76	1980	677
1891	5	1921	75	1951	93	1981	446
1892	7	1922	98	1952	93	1982	327
1893	7	1923	117	1953	93	1983	424
1894	6	1924	119	1954	88	1984	357
1895	6	1925	119	1955	94	1985	291
1896	6	1926	113	1956	105	1986	461
1897	6	1927	85	1957	90	1987	553
1898	15	1928	79	1958	66	1988	523
1899	6	1929	68	1959	72	1989	507
1900	6	1930	44	1960	83	1990	467
1901	20	1931	32	1961	83	1991	371
1902	20	1932	32	1962	83	1992	361
1903	19	1933	31	1963	82	1993	375
1904	21	1934	34	1964	90	1994	411
1905	17	1935	33	1965	100	1995	425
1906	28	1936	42	1966	100	1996	398
1907	NA	1937	47	1967	111	1997	397
1908	21	1938	34	1968	117	1998	373
1909	25	1939	36	1969	124		

NA Not available

[1] To convert to dollars per kilogram, multiply by 32.1507.

Note:

1880-1910, Annual average price of crude platinum, *in* Mineral Resources of the United States: U.S. Geological Survey annual.
1911-29, New York price of refined metal, *in* Hill, J.M., 1922, The marketing of platinum: Engineering & Mining Journal-Press, p. 718.
1930-66, Producer price at New York of 99.9%-pure platinum, *in* Engineering & Mining Journal, Mineral and Metal Markets.
1967-93, New York price per troy ounce of 99.9%-pure platinum in 50-ounce lots, *in* Metals Week [through June 14, 1993].
1993-98, New York price per troy ounce of 99.9%-pure platinum in 50-ounce lots, *in* Platt's Metals Week.

Annual Average Palladium Price

(Dollars per troy ounce[1])

Year	Price	Year	Price	Year	Price	Year	Price
1911	55	1933	18	1955	22	1977	49
1912	55	1934	23	1956	24	1978	63
1913	50	1935	23	1957	24	1979	120
1914	44	1936	23	1958	17	1980	201
1915	56	1937	23	1959	19	1981	95
1916	67	1938	23	1960	25	1982	67
1917	110	1939	23	1961	25	1983	136
1918	135	1940	24	1962	25	1984	148
1919	130	1941	24	1963	25	1985	107
1920	108	1942	24	1964	31	1986	116
1921	59	1943	24	1965	33	1987	130
1922	60	1944	24	1966	34	1988	123
1923	NA	1945	24	1967	38	1989	144
1924	94	1946	24	1968	45	1990	114
1925	79	1947	24	1969	42	1991	87
1926	70	1948	24	1970	38	1992	89
1927	58	1949	24	1971	37	1993	123
1928	46	1950	24	1972	42	1994	156
1929	40	1951	24	1973	78	1995	153
1930	24	1952	24	1974	133	1996	130
1931	18	1953	24	1975	93	1997	184
1932	18	1954	21	1976	51	1998	290

NA Not available

[1] To convert to dollars per kilogram, multiply by 32.1507.

Note:
1911-29, New York price of refined metal, *in* Hill, J.M., 1922, The marketing of platinum: Engineering & Mining Journal-Press, p. 718.
1930-66, Producer price at New York of 99.9%-pure palladium, *in* Engineering & Mining Journal, Mineral and Metal Markets.
1967-93, New York price per troy ounce of 99.9%-pure palladium in 100-ounce lots, *in* Metals Week [through June 14, 1993].
1993-98, New York price per troy ounce of 99.9%-pure palladium in 100-ounce lots, *in* Platt's Metals Week.

Annual Average Rhodium Price

(Dollars per troy ounce[1])

Year	Price	Year	Price	Year	Price	Year	Price
1930	50	1948	125	1966	198	1984	607
1931	50	1949	125	1967	225	1985	929
1932	43	1950	125	1968	247	1986	1,157
1933	49	1951	125	1969	240	1987	1,222
1934	56	1952	125	1970	215	1988	1,218
1935	53	1953	125	1971	200	1989	1,300
1936	65	1954	123	1972	197	1990	3,565
1937	111	1955	121	1973	222	1991	3,739
1938	125	1956	121	1974	329	1992	2,465
1939	125	1957	121	1975	338	1993	1,066
1940	125	1958	121	1976	348	1994	636
1941	125	1959	123	1977	409	1995	463
1942	125	1960	136	1978	524	1996	300
1943	125	1961	139	1979	770	1997	298
1944	125	1962	139	1980	729	1998	620
1945	125	1963	139	1981	498		
1946	125	1964	155	1982	323		
1947	125	1965	183	1983	312		

[1] To convert to dollars per kilogram, multiply by 32.1507.

Note:
1930-66, Producer price at New York of 99.9%-pure rhodium, *in* Engineering & Mining Journal, Mineral and Metal Markets.
1967-76, Producer price at New York of 99.9%-pure rhodium, *in* Metals Week.
1977-93, Dealer price at New York of 99.9%-pure rhodium, *in* Metals Week [through June 14, 1993].
1993-98, Dealer price at New York of 99.9%-pure rhodium, *in* Platt's Metals Week.

Annual Average Ruthenium Price

(Dollars per troy ounce[1])

Year	Price	Year	Price	Year	Price	Year	Price
1930	42	1948	92	1966	57	1984	103
1931	41	1949	75	1967	58	1985	101
1932	41	1950	76	1968	58	1986	73
1933	42	1951	93	1969	56	1987	70
1934	45	1952	86	1970	53	1988	61
1935	40	1953	86	1971	52	1989	62
1936	38	1954	67	1972	52	1990	61
1937	40	1955	52	1973	59	1991	55
1938	37	1956	50	1974	60	1992	29
1939	37	1957	50	1975	60	1993	13
1940	37	1958	50	1976	60	1994	22
1941	37	1959	56	1977	35	1995	26
1942	37	1960	55	1978	33	1996	43
1943	35	1961	57	1979	32	1997	37
1944	35	1962	57	1980	35	1998	47
1945	35	1963	57	1981	32		
1946	68	1964	57	1982	26		
1947	62	1965	57	1983	28		

[1] To convert to dollars per kilogram, multiply by 32.1507.

Note:
1930-66, Producer price at New York of refined metal, *in* Engineering & Mining Journal, Mineral and Metal Markets.
1967-76, Producer price at New York of 99.9%-pure ruthenium, *in* Metals Week.
1977-93, Dealer price at New York of 99.9%-pure ruthenium, *in* Metals Week [through June 14, 1993].
1993-98, Dealer price at New York of 99.9%-pure ruthenium, *in* Platt's Metals Week.